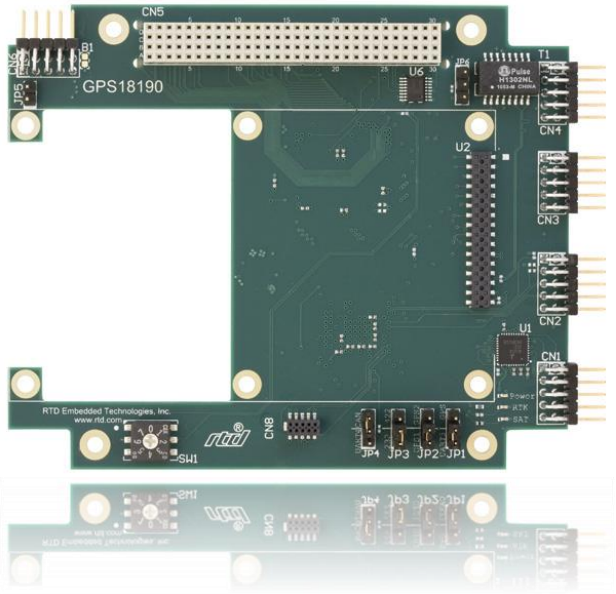
GPS18190

Trimble GPS Carrier module

User's Manual

BDM-610020090 Rev. B



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Revision History

Rev A	Initial Release
Rev B	Changed pin 4 of CN4 to RX-

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1 Introduction

1.1 Product Overview

The GPS18190 is designed to provide a PCI UART interface to a Trimble GPS. It uses a PCI/104 interface to the CPU module, and provides the ability to communicate with all three GPS serial interfaces. Additionally, the module provides connectors for Ethernet, CAN, and USB to the module. It is compatible with all PCI/104 modules.

1.2 Board Features

- PCI Interface to CPU
- Quad UART interface to Trimble GPS modules
- Ethernet connector to GPS module
- USB connector to GPS module
- CAN connector to GPS module
- External serial interface to GPS module, optionally a RS-232/422 serial port
- PCI Bus:
    - 32-bit, 33 MHz PCI Bus
    - PCI Target Controller allows PCI access to quad UART

1.3 Ordering Information

The GPS18190 is available with the following options:

Table 1: Ordering Options

Part Number	Description
GPS18190HR	Trimble GPS Carrier Module
GPS18190HR-xxx	GPS18190HR with Trimble BD970-xxx GPS
IDAN-GPS18190HRS	Trimble GPS Carrier Module in IDAN enclosure
IDAN-GPS18190HRS-xxx	GPS18190HR with Trimble BD970-xxx GPS in IDAN enclosure

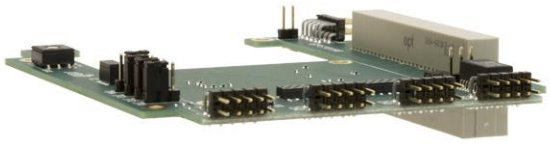

Figure 1: GPS18190HR (Above CPU)

The Intelligent Data Acquisition Node (IDAN™) building block can be used in just about any combination with other IDAN building blocks to create a simple but rugged 104™ stack. This module can also be incorporated in a custom-built RTD HiDAN™ or HiDANplus High Reliability Intelligent Data Acquisition Node. Contact RTD sales for more information on our high reliability systems.

1.4 Contact Information

1.4.1 Sales Support

For sales inquiries, you can contact RTD Embedded Technologies sales via the following methods:

Phone: 1-814-234-8087 Monday through Friday, 8:00am to 5:00pm (EST).
E-Mail: sales@rtd.com

1.4.2 Technical Support

If you are having problems with you system, please try the steps in the Troubleshooting section of this manual.

For help with this product, or any other product made by RTD, you can contact RTD Embedded Technologies technical support via the following methods:

Phone: 1-814-234-8087 Monday through Friday, 8:00am to 5:00pm (EST).
E-Mail: techsupport@rtd.com

2 Specifications

2.1 Operating Conditions

Table 2: Operating Conditions

Symbol	Parameter	Test Condition	Min	Max	Unit
V_{cc5}	5V Supply Voltage		4.75	5.25	V
T_a	Operating Temperature		-40	+85	C
T_s	Storage Temperature		-55	+125	C
RH	Relative Humidity	Non-Condensing	0	90%	%
MTBF	Mean Time Before Failure	Telcordia Issue 2 30°C, Ground benign, controlled		TBD	Hours

2.2 Electrical Characteristics

Table 3: Electrical Characteristics

Symbol	Parameter	Test Condition	Min	Max	Unit
P	Power Consumption	V_{cc5} = 5.0V		??	W
I_{cc5}	5V Input Supply Current	Active		100	mA
PCI Bus					
$V_{IH3.3}$	PCI 3.3V Input High Voltage	JP300 = 1-2 (3.3V)	1.65	3.3	V
$V_{IL3.3}$	PCI 3.3V Input Low Voltage	JP300 = 1-2 (3.3V)	0	0.7	V
V_{IH5}	PCI 5V Input High Voltage	JP300 = 2-3 (5V)	2.0	5.5	V
V_{IL5}	PCI 5V Input Low Voltage	JP300 = 2-3 (5V)	0	0.8	V
I_{IL}	PCI Input Leakage	0<V_I<VIO	-10	10	uA
I_{OZ}	PCI Hi-Z Leakage	0<V_I<VIO		10	uA
$V_{OH3.3}$	PCI 3.3V Output High Voltage	JP300 = 1-2 (3.3V), I_{OUT} = -0.5mA	2.97		V
$V_{OL3.3}$	PCI 3.3V Output Low Voltage	JP300 = 1-2 (3.3V) , I_{OUT} = 1.5mA		0.33	V
V_{OH5}	PCI 5V Output High Voltage	JP300 = 2-3 (5V) , I_{OUT} = -12mA	2.4		V
V_{OL5}	PCI 5V Output Low Voltage	JP300 = 2-3 (5V) , I_{OUT} = 12mA		0.4	V

3 Board Connection

3.1 Board Handling Precautions

To prevent damage due to Electrostatic Discharge (ESD), keep your board in its antistatic bag until you are ready to install it into your system. When removing it from the bag, hold the board at the edges, and do not touch the components or connectors. Handle the board in an antistatic environment, and use a grounded workbench for testing and handling of your hardware.

3.2 Physical Characteristics

- Weight: Approximately 55 g (0.12 lbs.)
- Dimensions: 90.17 mm L x 95.89 mm W (3.550 in L x 3.775 in W)

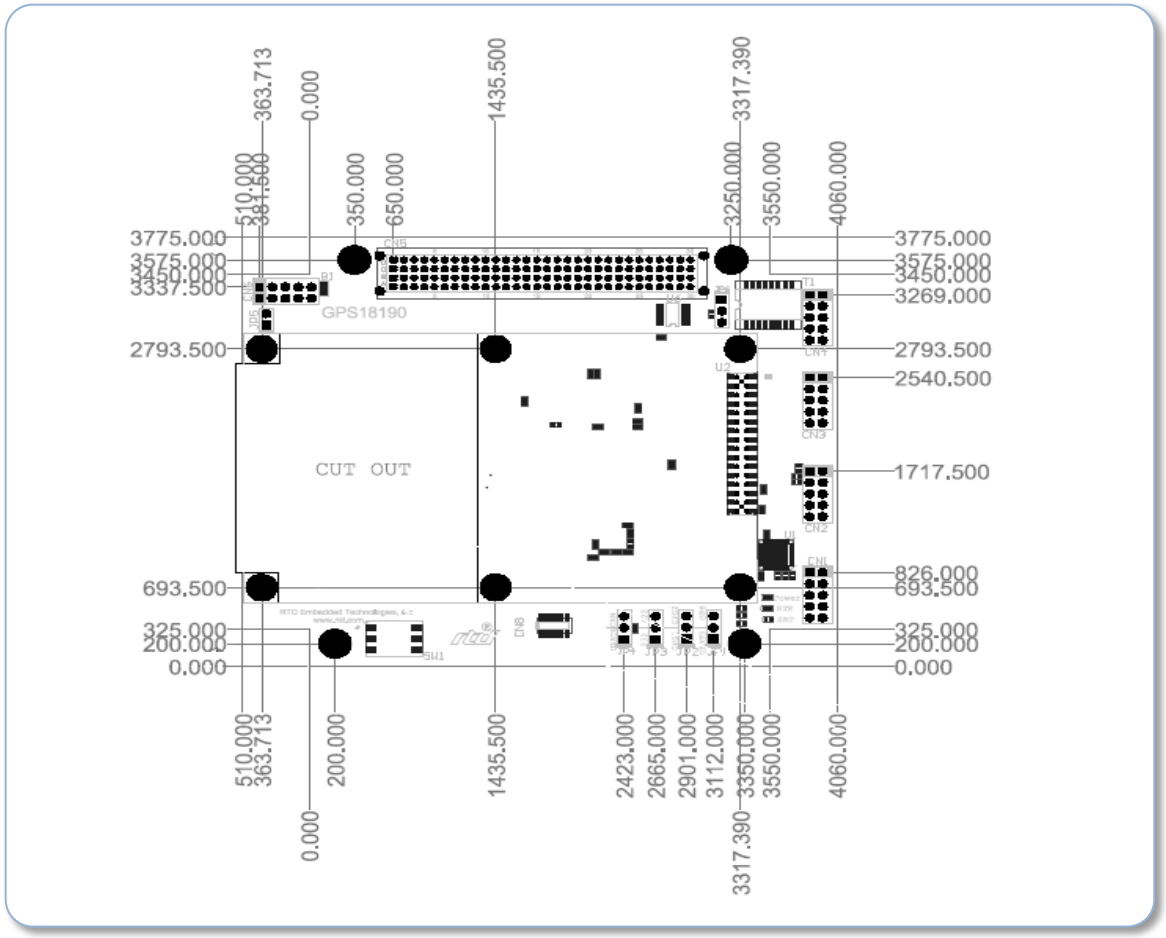

Figure 2: Board Dimensions

3.3 Connectors, Jumpers, and LEDs

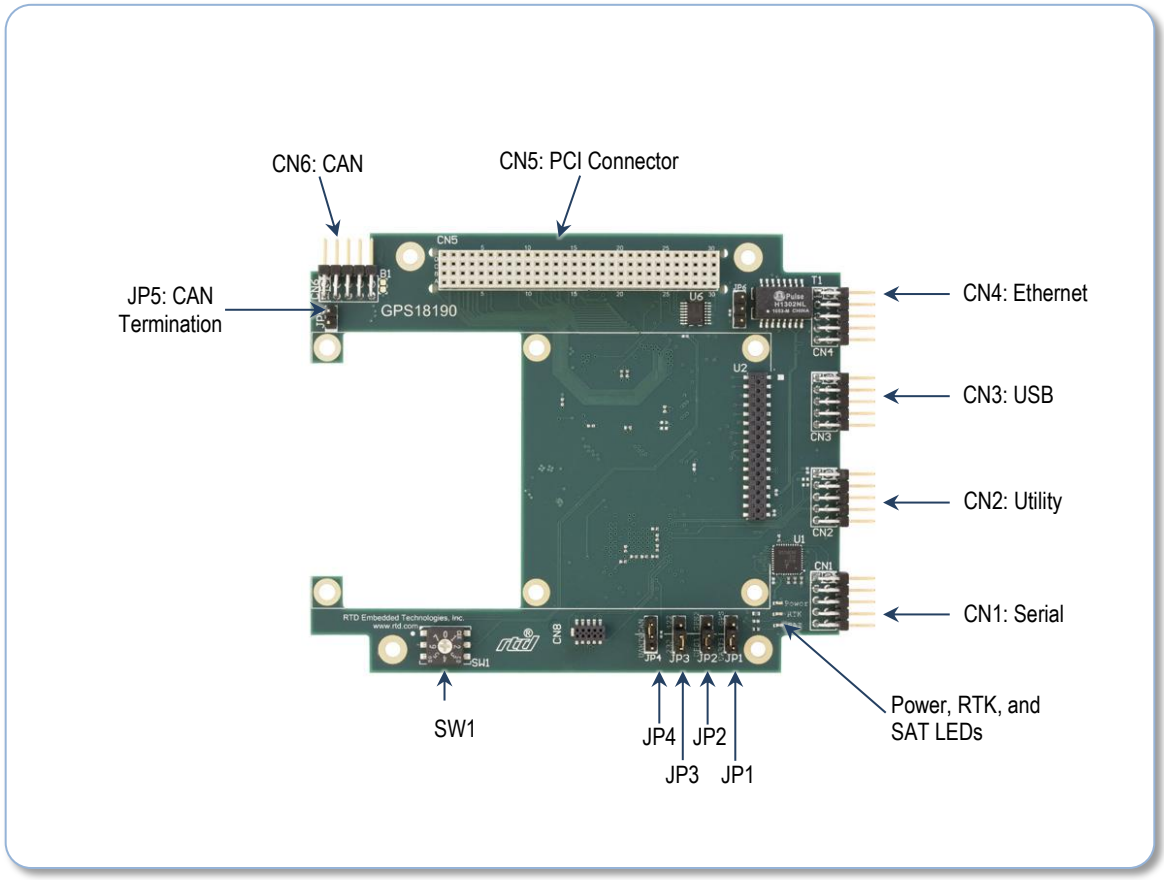

Figure 3: Board Connections, Jumpers, and LEDs

3.3.1 I/O CONNECTORS

All I/O connectors have Pin 1 designated by a thick white silkscreen line, and a square pad on the PCB.

CN1 Serial I/O Connector

CN1 is an RS-232/RS-422/RS-485 interface that can be configured to be a serial port off the CPU or one of the first two serial ports from the GPS. Table 4 is the pin out in RS-232 mode, if JP3 has pins 1 – 2 shorted.

Table 4 CN1 in RS-232 Mode

CN1 Pin	UART Connection	GPS Connection	Function	In/Out	DB-25	IDAN 9-pin "D"
1	DCD	-	Data Carrier Detect	In	8	1
2	DSR	-	Data Set Ready	In	6	6
3	RxD	RxD	Receive Data	In	3	2
4	RTS	RTS	Request To Send	Out	4	7
5	TxD	TxD	Transmit Data	Out	2	3
6	CTS	CTS	Clear To Send	In	5	8
7	DTR	-	Data Terminal Ready	Out	20	4
8	RI	-	Ring Indicator	In	22	9
9, 10	GND	GND	Signal Ground	-	7	5

Facing the connector, the pin out is:

9	7	5	3	1
GND	DTR	TxD	RxD	DCD
GND	RI	CTS	RTS	DSR
10	8	6	4	2

Table 5 is the pin out of CN1 in RS422/485 mode, if JP3 has pins 2 – 3 shorted. Note that when connected to the UART, RTS is used to enable the driver. When connected to the GPS the driver is always enabled.

Table 5 CN1 in RS-232 Mode

CN1 Pin	UART Signal	GPS Signal	Function	In/Out	DB-25	IDAN 9-pin "D"
1	-	-	Reserved	In	8	1
2	-	-	Reserved	In	6	6
3	RxD-	RxD-	Receive Data(-)	In	3	2
4	TxD+	TxD+	Transmit Data (+)	Out	4	7
5	TxD-	TxD-	Transmit Data(-)	Out	2	3
6	RxD+	RxD+	Receive Data (+)	In	5	8
7	-	-	Reserved	Out	20	4
8	-	-	Reserved	In	22	9
9, 10	GND	GND	Signal Ground	-	7	5

Facing the connector, the pin out is:

9	7	5	3	1
GND	Rvsd	TxD-	RxD-	Rvsd
GND	Rvsd	RxD+	TxD+	Rvsd
10	8	6	4	2

CN2 GPS Utility Connector

CN2 is the GPS Utility connector. It contains the GPS external reset, a buffered 1 pulse-per-second with a 7 ns maximum delay, the GPS Event 1 input, and three GPS LED signals. All signals go through the EPLD so they are 5 volt tolerant and the LED signals are capable of ±20mA. Table 6 is the pin out of the Utility connector.

Table 6 CN2 GPS Utility

CN2 Pin	Signal	Function	In/Out	IDAN 9-pin "D"
1	Reset	Pull low to reset GPS or leave open	In	1
2	1PPSb	Buffered 1 Pulse-per-Second from GPS	Out	6
3	GND	Signal Ground	-	2
4	Event1	GPS Event1 Signal	In	7
5	RTK LED	RTD LED from GPS	Out	3
6	3.3V	LED power supplied by GPS18190	-	8
7	PWR LED	Power LED from GPS	Out	4
8	3.3V	LED power supplied by GPS18190	-	9
9	SAT LED	SAT LED from GPS	Out	5
10	3.3V	LED power supplied by GPS18190	-	N/C

Facing the connector, the pin out is:

9	7	5	3	1
SAT LED	PWR LED	RTK LED	GND	Reset
3.3V	3.3V	3.3V	Event1	1PPSb
10	8	6	4	2

CN3 GPS USB Connector

CN3 is the GPS USB port. It connects directly to the GPS USB port. Table 6 is the pin out of the USB connector.

Table 7 CN3 GPS USB

CN3 Pin	Signal	Function	In/Out	IDAN 9-pin "D"
1	Rsvd	Reserved	-	1
2	Rsvd	Reserved	-	6
3	USB-Dn	USB data (+)	Bidirectional	2
4	Rsvd	Reserved	-	7
5	USB-Dp	USB data (-)	Bidirectional	3
6	Rsvd	Reserved	-	8
7	GND	Signal Ground	-	4
8	GND	Signal Ground	-	9
9	GND	Signal Ground	-	5
10	GND	Signal Ground	-	N/C

Facing the connector, the pin out is:

9	7	5	3	1
GND	GND	USB-Dp	USB-Dn	Rsvd
GND	GND	Rsvd	Rsvd	Rsvd
10	8	6	4	2

CN4 GPS 10/100 Mbps Ethernet Connector

CN4 is the GPS 10/100 Mbps Ethernet port. The GPS18190 provides the magnetics required to connect the GPS directly to 10/100 Mbps network. It is full duplex with auto-negotiation enabled. Table 8 is the pin out of the Ethernet connector.

Table 8 CN4 GPS Ethernet

CN4 Pin	Signal	Function	IDAN 9-pin "D"
1	RX+	Receive+	1
2	RX-	Receive-	6
3	Term	Ethernet Termination	2
4	Term	Ethernet Termination	7
5	TX+	Transmit+	3
6	TX-	Transmit-	8
7	Term	Ethernet Termination	4
8	Term	Ethernet Termination	9
9	AGND	Ethernet Ground	5
10	AGND	Ethernet Ground	N/C

Facing the connector, the pin out is:

9	7	5	3	1
AGND	Term	TX+	Term	RX+
AGND	Term	TX-	Term	RX-
10	8	6	4	2

CN6 GPS CAN Bus Connector

CN6 is the GPS CAN Bus port. The GPS18190 provides the CAN transceiver required to connect the GPS directly to CAN network. This requires the GPS module to configure COM3 as CAN. Jumper JP4 controls the GPS to CAN transceiver connection. If JP4 has pins 1 – 2 shorted GPS COM3 is connected to the UART channel 3. If JP4 has pins 2 – 3 shorted GPS COM3 is connected to the CAN transceiver. Table 9 is the pin out of the Ethernet connector.

Table 9 CN6 GPS CAN

CN4 Pin	Signal	Function	IDAN 9-pin "D"
1	Rsvd	Reserved	1
2	GND	Signal Ground	6
3	CAN-L	CAN bus data low	2
4	CAN-H	CAN bus data high	7
5	GND	Signal Ground	3
6	Rsvd	Reserved	8
7	Rsvd	Reserved	4
8	+5V*	*Provides +5 volts if B1 is shorted. Default is B1 open.	9
9	GND	Signal Ground	5
10	Rsvd	Reserved	N/C

Facing the connector, the pin out is:

9	7	5	3	1
GND	Rsvd	GND	CAN-L	Rsvd
Rsvd	+5V*	Rsvd	CAN_H	GND
10	8	6	4	2

3.3.2 BUS CONNECTORS

CN5: PCI Connector

The PCI connector is the connection to PCI peripheral modules. The position and pin assignments are compliant with the *PCI/104 Specification*. (See PC/104 Specifications on page 26)

3.3.3 JUMPERS

On all jumpers, pin 1 is designated by a thick white silkscreen line, and a square pad on the PCB.

JP1 and JP2: CN1 Serial Port Source

JP1 and JP2 are 3-pin two position jumpers that are used to select if the UART or a GPS serial port is connected to CN1. These jumpers affect UART serial ports 1, 2, and 4 as well as GPS serial ports 1 and 2. Table 10 has JP1 and JP2 setting information.

Table 10: JP1 and JP2 Settings

JP1 Setting	JP2 Setting	Description	Notes
1 – 2	Any Position	GPS serial port 1 connected to UART serial port 1 GPS serial port 2 connected to UART serial port 2 UART serial port 4 is connected to CN1	Factory default is 1 – 2 for both JP1 and JP2
2 – 3	1 – 2	GPS serial port 1 connected to CN1 GPS serial port 2 connected to UART serial port 2 UART serial port 1 monitors GPS serial port 1 UART serial port 4 is unused	
	2 – 3	GPS serial port 1 connected to UART serial port 1 GPS serial port 2 connected to CN1 UART serial port 2 monitors GPS serial port 2 UART serial port 4 is unused	

JP3: CN1 Serial Port Mode

JP3 is used to select the mode of serial port CN1. The options are shown in Table 11.

Table 11: JP3 Settings

Setting	Description	Notes
1 – 2	RS-232	Factory default
2 – 3	RS-422/485	

Note that in RS-422 mode when connected to the UART (JP1 is 1 – 2) RTS is used to enable the driver. When connected to the GPS (JP1 is 2 – 3) the driver is always enabled.

JP4: GPS Serial Port 3 Connection

JP4 is used to select the connection of GPS serial port 3. The options are shown in Table 12.

Table 12: JP4 Settings

Setting	Description	Notes
1 – 2	GPS serial port 3 connected to UART serial port 3	Factory default
2 – 3	GPS serial port 3 connected to CAN transceiver CN6 UART serial port 3 monitors GPS serial port 1	

JP5: CAN Bus Termination

JP5 is used terminate the CAN bus. If this device is not at the end of the CAN bus remove this jumper. The options are shown in Table 13: JP5 Settings.

Table 13: JP5 Settings

Setting	Description	Notes
1 – 2 Short	CAN Bus Terminated	Factory default
1 – 2 Open	CAN Bus Not Terminated	

3.3.4 LEDs

Power LED

The Power LED is connected to the POWER LED signal of the GPS. It is on when power is applied to the GPS module.

Real-Time Kenematic LED

The RTK LED is connected to the RTK LED signal of the GPS. It flashes slowly when an RTK correction is present.

Satellite LED

The Satellite (SAT) LED is connected to the SAT LED signal of the GPS. It flashes rapidly to indicate less than 5 satellites and slowly flashes to indicate more than 5 satellites.

3.4 Steps for Installing

1. Always work at an ESD protected workstation, and wear a grounded wrist-strap.
2. Turn off power to the PC/104 system or stack.
3. Select and install stand-offs to properly position the module on the stack.
4. Remove the module from its anti-static bag.
5. Check that pins of the bus connector are properly positioned.
6. Check the stacking order; make sure all of the busses used by the peripheral cards are connected to the cpuModule.
7. Hold the module by its edges and orient it so the bus connector pins line up with the matching connector on the stack.
8. Gently and evenly press the module onto the PC/104 stack.
9. If any boards are to be stacked above this module, install them.
10. Attach any necessary cables to the PC/104 stack.
11. Re-connect the power cord and apply power to the stack.
12. Boot the system and verify that all of the hardware is working properly.

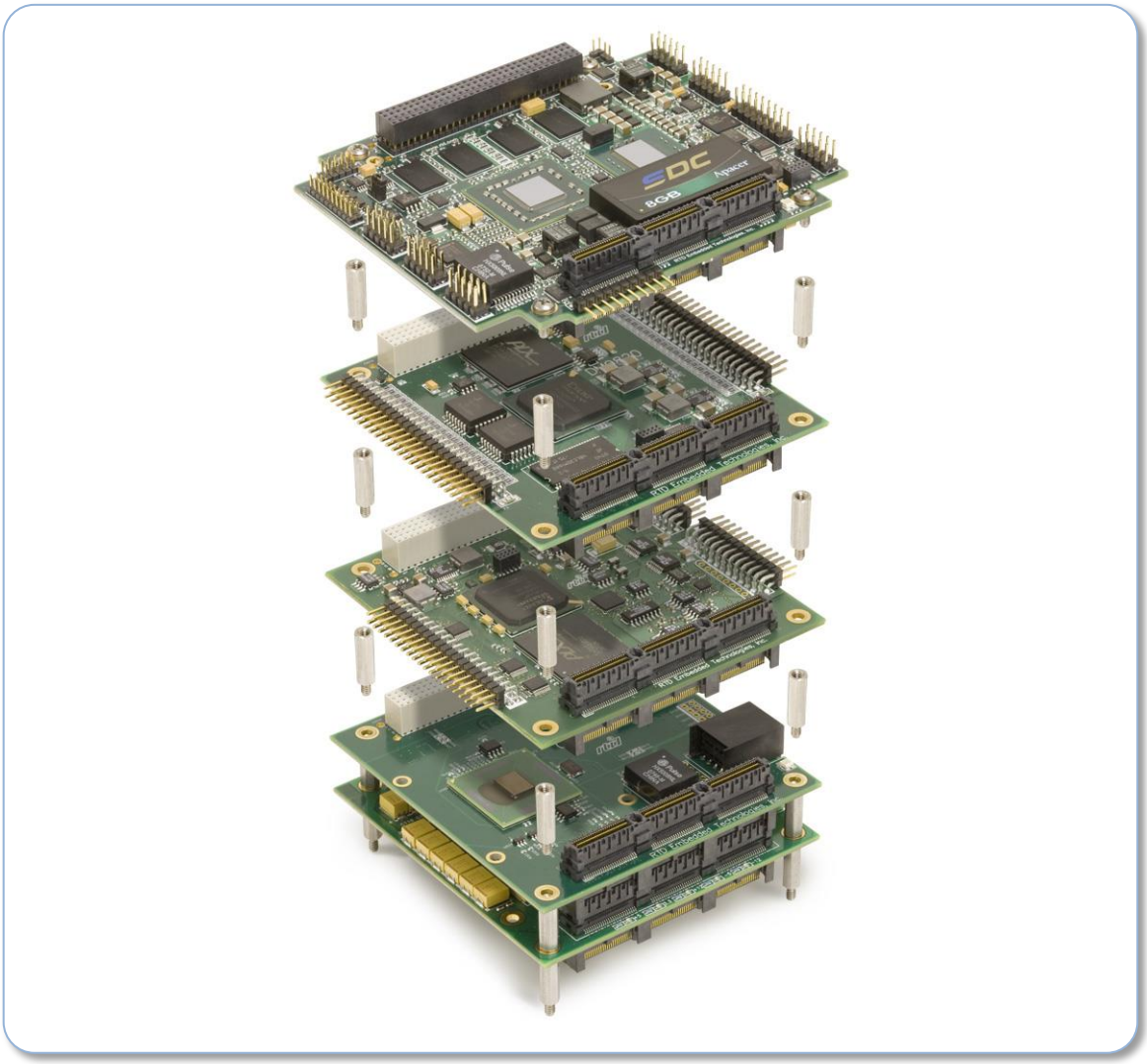

Figure 4: Example 104™ Stack

4 IDAN Connections

4.1 Module Handling Precautions

To prevent damage due to Electrostatic Discharge (ESD), keep your module in its antistatic bag until you are ready to install it into your system. When removing it from the bag, hold the module by the aluminum enclosure, and do not touch the components or connectors. Handle the module in an antistatic environment, and use a grounded workbench for testing and handling of your hardware.

4.2 Physical Characteristics

- Weight: Approximately 0.21 Kg (0.46 lbs.)
- Dimensions: 151.972 mm L x 129.978 mm W x 16.993 mm H (5.983 in L x 5.117 in W x 0.669 in H)

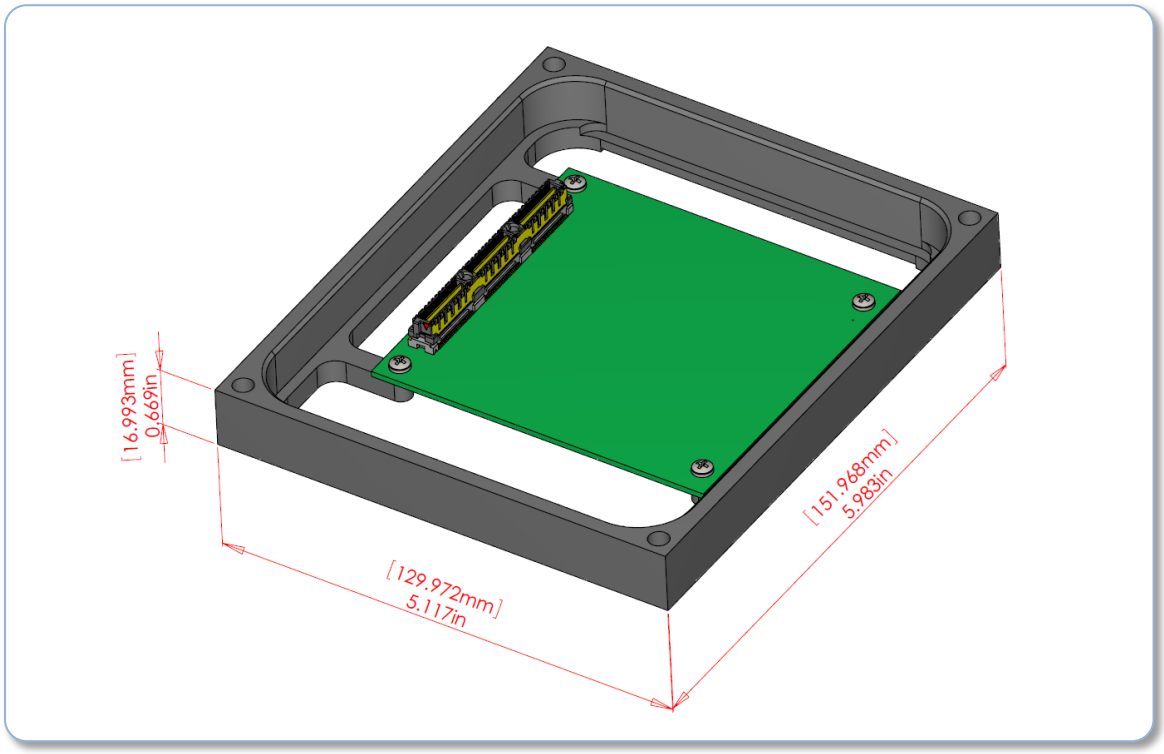

Figure 5: IDAN Dimensions

4.3 Connectors

4.3.1 External I/O Connectors

There are no external I/O connectors on the GPS18190

4.3.2 Bus Connectors

CN1(Top) & CN2(Bottom): PCIe Connector

The PCIe connector is the connection to the system CPU. The position and pin assignments are compliant with the *PCI/104-Express Specification*. (See PC/104 Specifications on page 26)

The GPS18190 is a "Universal" board, and can connect to either a Type 1 or Type 2 PCIe/104 connector.

CN16: PCI Connector

The PCI connector is the connection to PCI peripheral modules. The position and pin assignments are compliant with the *PCI/104-Express Specification*. (See PC/104 Specifications on page 26)

4.4 Steps for Installing

1. Always work at an ESD protected workstation, and wear a grounded wrist-strap.
2. Turn off power to the IDAN system.
3. Remove the module from its anti-static bag.
4. Check that pins of the bus connector are properly positioned.
5. Check the stacking order; make sure all of the busses used by the peripheral cards are connected to the cpuModule.
6. Hold the module by its edges and orient it so the bus connector pins line up with the matching connector on the stack.
7. Gently and evenly press the module onto the IDAN system.
8. If any boards are to be stacked above this module, install them.
9. Finish assembling the IDAN stack by installing screws of an appropriate length.
10. Attach any necessary cables to the IDAN system.
11. Re-connect the power cord and apply power to the stack.
12. Boot the system and verify that all of the hardware is working properly.

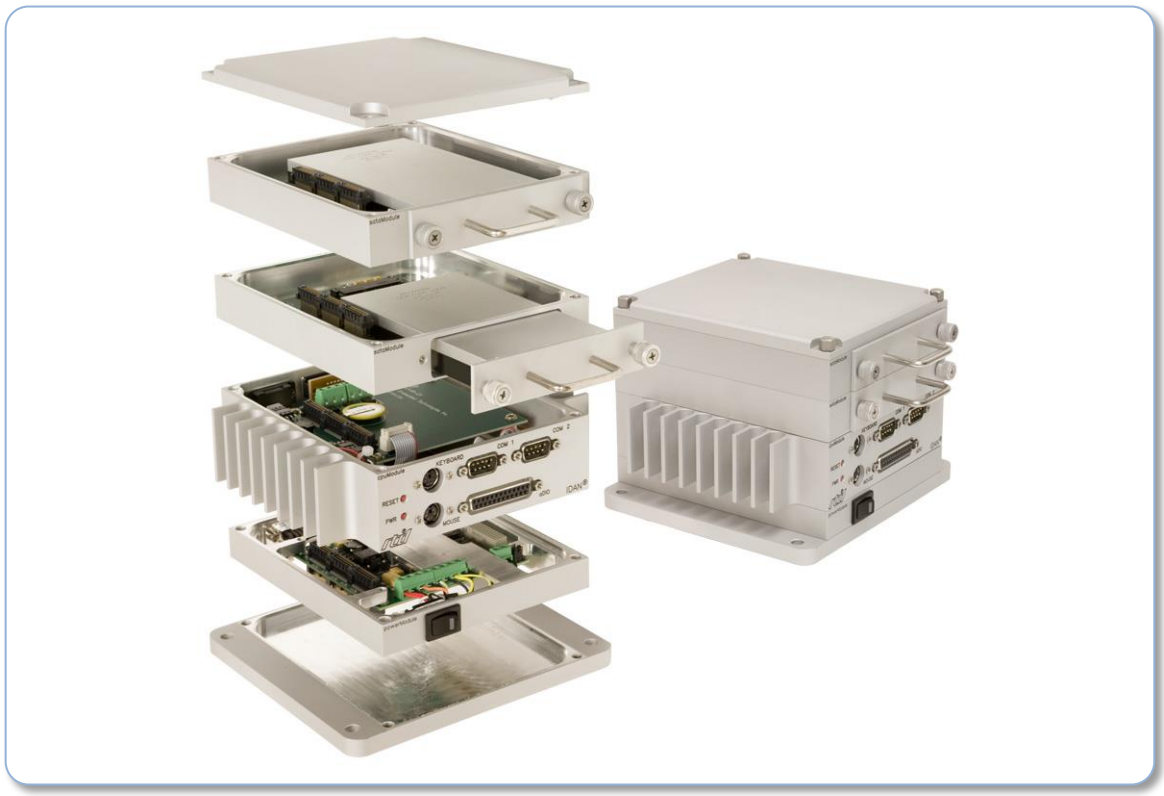

Figure 6: Example IDAN System

5 Functional Description

5.1 Block Diagram

The Figure below shows the functional block diagram of the GPS18190. The various parts of the block diagram are discussed in the following sections.

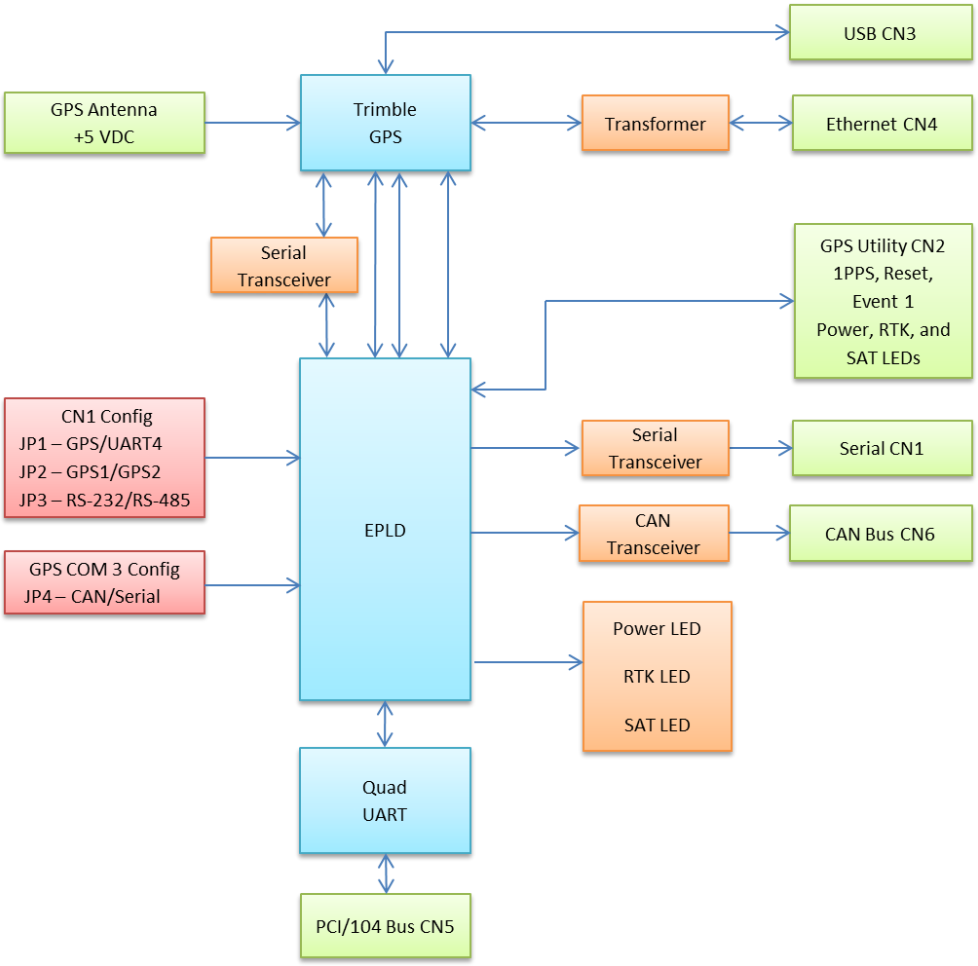

Figure 7: GPS18190 Block Diagram

5.2 GPS Interface

The GPS18190 is a carrier board for a Trimble GPS receiver. It provides a quad UART interface to the PCI bus that can be connected to all three serial ports of the GPS and serial connector CN1. Optionally, one of the GPS serial ports can be connected to CN1. If the GPS module has CAN bus capability on the third serial port, it can be connected to an onboard CAN transceiver. The GPS antenna connects directly to the GPS module.

5.2.1 GPS Antenna

The GPS antenna connects directly to the GPS module.

5.2.2 PCI Bus UARTS

The GPS18190 has four PCI bus UARTS. By default they are connected as follows:

- UART 1 to GPS COM1
- UART 2 to GPS COM2

- UART 3 to GPS COM3
- UART 4 to serial port connector CN1

Jumper JP1 and JP2 selection may disable some of these ports to allow the GPS COM ports to connect to serial connector CN1 or CAN connector CN6. See 3.3.3 Jumpers on page 18.

5.2.3 CN1 Serial Port

CN1 is a serial that can be configured as RS-232 or RS-422/485 with jumper JP3, see Table 11: JP3 Settings. This serial port by default is connected to the PCI UART 4. In this mode it is a full serial port in RS-232 mode and supports TxD+/- and RxD+/- in RS-422/485 mode.

JP1 and JP2 can be used to configure it to be GPS COM1 or COM2. See Table 10: JP1 and JP2 Settings. When connected to the GPS the serial port only uses TxD, RxD, RTS, and CTS. Additionally, the GPS one pulse-per-second signal is connected to the CD pin.

5.2.4 CN2 GPS Utility Port

The GPS18190 GPS Utility Port provides the GPS one pulse-per-second signal buffered through the EPLD. The EPLD add a maximum of 7ns delay to the signal. The GPS Event1 and Reset inputs are buffered through the EPLD to make these signals 5 volt tolerant. The Utility Port also provides buffered RTK, SAT, and Power signals for external LEDs.

5.2.5 CN3 GPS USB

CN3 is connected directly to the GPS USB port. It does not provide or require +5 volts.

5.2.6 CN4 GPS Ethernet

CN3 is connected to the GPS Ethernet Port through a 10/100 Mbps transformer.

5.2.7 CN6 GPS CAN Bus

CN6 is has a CAN bus driver that provides:

- Bus-Fault Protection of ±36 V
- Meets or Exceeds ISO 11898 ISO 11898 Standard
- Signaling Rates Up to 1 Mbps
- Bus Pin ESD Protection Exceeds 14 kV HBM
- Unpowered Node Does Not Disturb the Bus
- Glitch-Free Power-Up and Power-Down Bus Protection For Hot-Plugging

5.3 Power

The GPS18190 only requires +5V to operate which is supplied through the PCI/104 PCI bus.

6 Troubleshooting

If you are having problems with your system, please try the following initial steps:

- **Simplify the System** – Remove modules one at a time from your system to see if there is a specific module that is causing a problem. Perform you troubleshooting with the least number of modules in the system possible.

- **Swap Components** – Try replacing parts in the system one at a time with similar parts to determine if a part is faulty or if a type of part is configured incorrectly.

If problems persist, or you have questions about configuring this product, contact RTD Embedded Technologies via the following methods:

Phone: +1-814-234-8087
E-Mail: techsupport@rtd.com

Be sure to check the RTD web site (http://www.rtd.com) frequently for product updates, including newer versions of the board manual and application software.

7 Additional Information

7.1 PC/104 Specifications

A copy of the latest PC/104 specifications can be found on the webpage for the PC/104 Embedded Consortium:

www.pc104.org

7.2 PCI and PCI Express Specification

A copy of the latest PCI and PCI Express specifications can be found on the webpage for the PCI Special Interest Group:

www.pcisig.com

8 Limited Warranty

RTD Embedded Technologies, Inc. warrants the hardware and software products it manufactures and produces to be free from defects in materials and workmanship for one year following the date of shipment from RTD Embedded Technologies, Inc. This warranty is limited to the original purchaser of product and is not transferable.

During the one year warranty period, RTD Embedded Technologies will repair or replace, at its option, any defective products or parts at no additional charge, provided that the product is returned, shipping prepaid, to RTD Embedded Technologies. All replaced parts and products become the property of RTD Embedded Technologies. Before returning any product for repair, customers are required to contact the factory for a Return Material Authorization (RMA) number.

This limited warranty does not extend to any products which have been damaged as a result of accident, misuse, abuse (such as: use of incorrect input voltages, improper or insufficient ventilation, failure to follow the operating instructions that are provided by RTD Embedded Technologies, “acts of God” or other contingencies beyond the control of RTD Embedded Technologies), or as a result of service or modification by anyone other than RTD Embedded Technologies. Except as expressly set forth above, no other warranties are expressed or implied, including, but not limited to, any implied warranties of merchantability and fitness for a particular purpose, and RTD Embedded Technologies expressly disclaims all warranties not stated herein. All implied warranties, including implied warranties for merchantability and fitness for a particular purpose, are limited to the duration of this warranty. In the event the product is not free from defects as warranted above, the purchaser's sole remedy shall be repair or replacement as provided above. Under no circumstances will RTD Embedded Technologies be liable to the purchaser or any user for any damages, including any incidental or consequential damages, expenses, lost profits, lost savings, or other damages arising out of the use or inability to use the product.

Some states do not allow the exclusion or limitation of incidental or consequential damages for consumer products, and some states do not allow limitations on how long an implied warranty lasts, so the above limitations or exclusions may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

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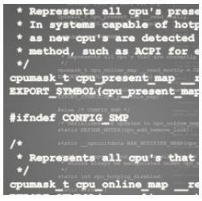

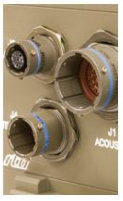
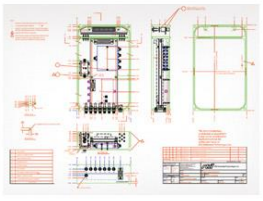

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